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REQUIREMENTS FOR SETTLING TANK (CLARIFIER EQUIPMENT) FOR WATER TREATMENT PLANT

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Indian Standard

REQUIREMENTS FOR SETTLING TANK (CLARIFIER EQUIPMENT) FOR WATER TREATMENT PLANT

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Indian Standard

REQUIREMENTS FOR SETTLING TANK (CLARIFIER EQUIPMENT) FOR WATER TREATMENT PLANT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 September 1982, after the draft finalized by the Public Health Engineering Equipment Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Settling tanks (sedimentation tanks, sedimentation basins or clarifiers) are used in water treatment to reduce the amount of settleable solids which are present in water.

0.2.1 Sedimentation usually finds application in two principal ways in water treatment, that is, plain sedimentation and sedimentation following coagulation, flocculation or softening. Plain sedimentation is used to remove settleable solids that occur naturally in surface waters. These solids settle without any previous treatment. Plain sedimentation is usually used as a preliminary process to reduce heavy sediments prior to subsequent treatment process such as coagulation. This is often referred to as pre-sedimentation or primary clarification.

0.2.2 Sedimentation following chemical coagulation and flocculation is used to remove suspended solids that have been rendered settleable by chemical treatment.

0.3 Factors that influence sedimentation are:

a) size, shape and weight of particle;
b) viscosity and temperature of water;
c) surface overflow;
d) surface area;
e) velocity of flow;
f) inlet and outlet arrangement;
g) detention periods; and
h) effective depth of basins.

0.3.1 Recommendations given below for overflow rates, minimum side water depth, detention time, weir loadings, bottom slopes are only general guidance and indicate the basis of preparations of this specification:

a) *Overflow rates* — For effective settling, the overflow rates shall not exceed the hydraulic subsidence value of the particles required to be removed. In horizontal flow circular tanks overflow rates varies from 30 to 40 $m^3/d/m^2$ while in vertical flow tanks, the range varies from 40 to 50 $m^3/d/m^2$.

b) *Minimum side water depth* — The minimum side water depth in rectangular or circular horizontal flow tanks shall not be less than 2·5 m.

c) *Detention time* — For plain settling tanks, the detention time varies from 3 to 4 hours while for coagulated water it varies between 2 to 2½ hours. For solid contact units (usually vertical flow settling tanks), the detention time used is 1 to 1½ hours.

d) *Weir loading* — Normal weir loadings are up to 300 $m^3/d/m$. Higher weir loading can be obtained when tanks are properly designed.

e) *Bottom slopes* — In circular tanks, where mechanical scrapers are provided, the floor slopes shall not be flatter than 1 in 12 and for manual cleaning, the slope shall be about 1 in 10. In non-mechanised horizontal flow rectangular settling tanks, the basin floors shall slope about 10 percent from the sides towards the longitudinal central line adopting a longitudinal slope of at least 5 percent from the shallow outlet end towards the deeper inlet area where the drain is normally located.

For sludge blanket type vertical flow settling tanks, the slopes of hoppers shall not be less than 60° to the horizontal. If sludge is to be withdrawn continuously or nearly continuously from the bottom of the basin by gravity without mechanical equipment, the slope of hopper bottom shall not be less than 55° to the horizontal.

0.4 In the formulation of this standard due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers requirements for settling tank (clarifier equipment) for water treatment plant.

2. MATERIAL OF CONSTRUCTION

2.1 Materials to be used in different components are given in Table 1.

3. DESCRIPTION OF CONSTRUCTION

3.1 Influent Pipe

3.1.1 The influent pipe laid underneath the floor of clarifier (circular or square) shall be embedded in concrete or in compacted sand in a excavated trench to ensure adequate protection to the pipe against settlement of concrete structure or subsoil water pressure. Pipe/pressure conduit and pipe joint after laying and before being embedded in concrete or before the floor of clarifier is laid shall be hydraulically tested to 2 times the maximum working static head and for internal and external pressures.

3.1.2 The inlet pipe laid inside the tank, up to the dispersion box (acting as deflector) shall be adequately supported from the fixed bridge walkway. The dispersion box shall be made of mild steel plate not less than 6 mm thick, adequately stiffened.

3.1.3 Inlet pipe for hopper bottom tank shall be laid across up to the centre and brought down vertically into the hopper portion. A typical illustration of hopper bottom tank is shown in Fig. 1.

3.1.4 In the case of long horizontal settling tank, inlet pipe is fitted to a distribution channel inside at one end. This inlet channel shall be provided with adequate number of orifice holes at its bottom to provide uniform distribution of flow across the width of the tank.

3.2 Sludge Draw Off Pipe

3.2.1 Pipes after laying and jointing shall be tested to 2 times the maximum working hydrostatic head. The pipe laying shall be done as described in **3.1.1** for circular or square settling tank.

3.2.2 For hopper bottom, sludge pipe shall follow the inclined surface of the hopper and come out of the tank through the vertical wall of the settling tank as shown in Fig. 1.

3.2.2.1 For constant bleeding of sludge, telescopic pipe arrangement shall be provided.

TABLE 1 MATERIAL FOR CONSTRUCTION FOR DIFFERENT COMPONENTS OF SETTLING TANK (CLARIFIER EQUIPMENT) FOR WATER TREATMENT PLANT

(*Clause* 2.1)

Sl No.	Components	Material	Reference to Indian Standards
(1)	(2)	(3)	(4)
1.	a) Influent pipe (Pipe laid across the tank inside)	Cast iron pipe Steel pipe (lined) RCC conduit	Class LA of IS : 1536-1976* or IS : 1537-1976†
	b) Pipe fittings	Cast iron	IS : 1538-1976‡
2.	*Sludge draw off pipe*		
	a) Pipe	Cast iron	IS : 1536-1976* and IS : 1537-1976†
	b) Sluice valve	Cast iron	IS : 780-1980§
3.	*Sludge scrapping*		
	a) Scraper blades	Mild steel	IS : 226-1975‖
	b) Frame/rake arm	Mild steel	IS : 226-1975‖
	c) *Rotating/fixed bridge*		
	i) Bridge	Mild steel RCC	IS : 226-1975‖
	ii) Traction rail	Mild steel	IS : 226-1975‖
	iii) Walkway	Anti corrosive paint or Epoxy painted or galvanized mild steel grill or galvanized chequered plate	IS : 226-1975‖
	iv) Handrailing	Anti corrosive paint or Epoxy painted or galvanized mild steel angle or galvanized tube	IS : 226-1975‖
	d) *Driving equipment*		
	i) Main driving wheel	Cast iron Cast steel	IS : 210-1978¶ IS : 1030-1974**
	ii) Worm gear	Cast iron Cast aluminium bronze	IS : 210-1978¶ IS : 617-1975††
	iii) Bevel gear	Cast iron	IS : 210-1978¶
	iv) Spur gear	Alloy steel	IS : 1570-1961‡‡

(*Continued*)

TABLE 1 MATERIAL FOR CONSTRUCTION FOR DIFFERENT COMPONENTS OF SETTLING TANK (CLARIFIER EQUIPMENT) FOR WATER TREATMENT PLANT — *Contd*

Sl No.	Components	Material	Reference to Indian Standards
(1)	(2)	(3)	(4)
	v) Gear box cover	Cast iron	IS : 210-1978¶
	vi) Cover for main driving wheel	Mild steel (epoxy coated or galvanized)	IS : 226-1975‖
		Cast iron	IS : 210-1978¶
	vii) Housing for main driving wheel	Cast iron	IS : 210-1978¶
	viii) Worm gear housing	Cast iron	IS : 210-1978¶
	ix) Bearing balls	High carbon steel	IS : 2898-1976§§
	x) Coupling	Cast iron	IS : 2693-1964‖‖
	xi) Chain sprocket drive	Steel	IS : 2403-1975¶¶
	xii) Traction wheel	Rubber/chrome-nickel tyred or carbon steel case hardened	—
	xiii) Shaft	Cold finished steel	IS : 1570-1961‡‡
	xiv) Cage	Mild steel	IS : 226-1975‖
	xv) Weirs	Mild steel	IS : 226-1975‖
		Fibre reinforced Plastic	— —
	xvi) Dispersion box	Mild steel	IS : 226-1975‖

*Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (*second revision*).

†Specification for vertically cast iron pressure pipes for water, gas and sewage (*first revision*).

‡Specification for cast iron fittings for pressure pipes for water, gas and sewage (*second revision*).

§Specification for sluice valves for water-works purposes (50 to 300 mm size) (*fourth revision*).

‖Specification for structural steel (standard quality) (*fifth revision*).

¶Specification for grey iron castings (*third revision*).

**Specification for carbon steel castings for general engineering purposes (*second revision*).

††Specification for aluminium and aluminium alloy ingots and castings for general engineering purposes (*second revision*).

‡‡Schedules for wrought steels for general engineering purposes.

§§Specification for steel balls for rolling bearings (*first revision*).

‖‖Specification for cast iron flexible couplings.

¶¶Specification for transmission steel roller chains and chain wheels (*first revision*).

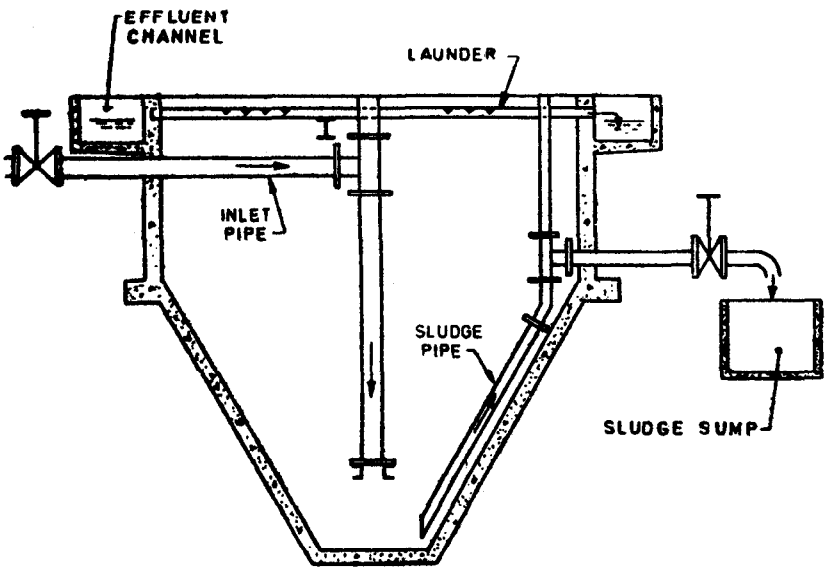


FIG. 1 TYPICAL SKETCH OF HOPPER BOTTOM SETTLING TANK

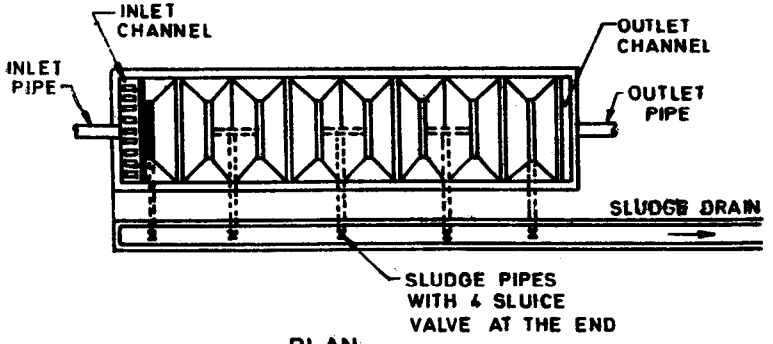
3.2.2.2 For non-mechanised units, pipe diameters of 200 mm or larger are recommended. Pipe diameters of 100 to 150 mm are preferred for mechanised units with continuous removal of sludge arrangement.

3.2.3 For long rectangular settling tank, ridge and furrow arrangement along the length of the tank shall be provided for the collection of sludge (*see* Fig. 2).

3.2.4 *Sludge Draw Off Valve*

3.2.4.1 The sludge draw off valve may be of cast iron sluice valves, or cast iron rubber-lined diaphragm valves. Where the valve is well below ground level, mild steel extension spindle fitted with hand wheel shall be provided for convenience of operation.

3.2.4.2 In case timer controlled sludge valve is used, a by-pass with a sluice valve shall be provided for the same. In addition, two sluice valves, one on either side of the timer controlled valve shall be used to enable the latter to be completely removed for repairs if so required at any time. This timer controlled sludge valve shall be rising spindle type sluice valve with cylinder. Either water or pneumatic pressure shall only



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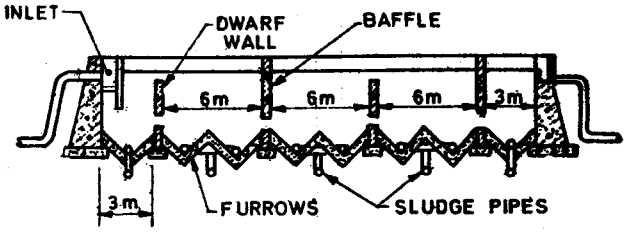

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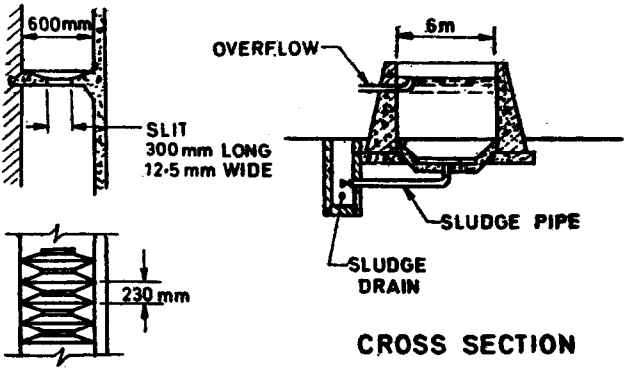

DETAILS OF SLITS IN INLET CHANNEL

CROSS SECTION

FIG. 2 TYPICAL DETAILS OF RECTANGULAR SETTLING TANK

be used for the operation of above valves. Timer shall be electrically operated mechanical type or electronic. A solenoid operated pilot valve is required to operate the above valves.

3.2.4.3 For constant bleeding of sludge from the pipe line, a by-pass connection upstream of main sludge valve (**3.2.4.1**) shall be provided. A typical arrangement of constant bleed tank is shown in Fig. 3. Adequate arrangement for collection of sludge overflowing through the constant bleeding arrangement shall be provided.

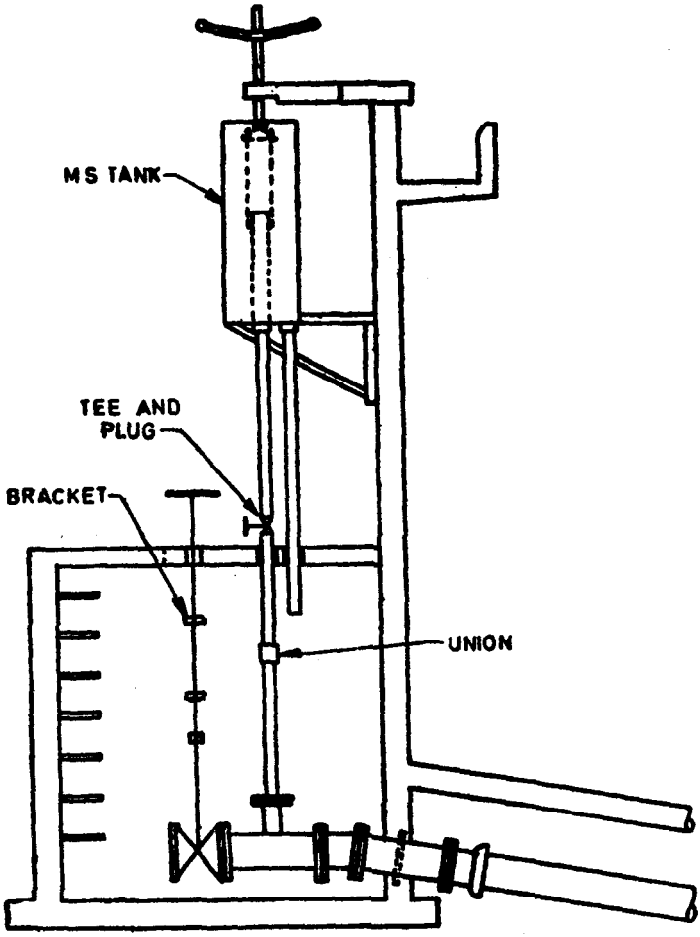

FIG. 3 TYPICAL SKETCH OF CONSTANT BLEED TANK

4. CLARIFIED/SETTLED WATER COLLECTION FROM TOP

4.1 For circular or square tank, normally peripheral collecting launder is provided. To ensure uniform collection all along the periphery orifices at predetermined points or mild steel weir plate with 90° 'V' notches along with suitable weir clamps shall be provided. Weir plate shall not be less than 6 mm thick (*see* IS : 9108-1979*).

4.1.1 Anchor bolts shall be of galvanized steel.

4.2 For long rectangular settling tank over 20 m length, series of collecting launders with inter-connection across the width of the tank at the opposite end of inlet shall be provided to cater for the required weir loading. These launders may have weir plate or submerged orifice holes.

5. SLUDGE SCRAPPING

5.1 For circular, square and rectangular tank without hopper bottom sludge scrapping mechanism shall be provided. Long rectangular tanks without sludge scrapping mechanism with duplicate tank as stand-by for manual sludge cleaning may be used. For horizontal flow rectangular settling tanks, scraper supported on travelling bridge moving to and fro along the length or scraper mounted on endless chain may be provided.

5.2 Sludge scrapping is done by inclined steel plates known as scraper blades fitted to the structural steel rake arm or frame. Blades shall be inclined to the axis of the frame or rake, so as to push the sludge towards centre. Blades are normally straight or curved inward. Horizontal projection of scrapers blades shall overlap each other. Scrapping blades are provided normally for ½ or full diameter of the tank depending on its size and also considering peripheral speed of the scrapping arm. This scrapping arm is either attached to a rotating bridge by means of vertical supports or attached to a centre drive cage. Rotating bridge is driven by a motor, reduction gear box, etc, at the periphery and centre drive cage is driven by the same method at the centre of the tank. Further scraper arm extending full diameter of the tank can also be driven by a rotating bridge driven at the periphery, scraper arm being attached to centre cage which is in turn fixed to the rotating bridge at the centre of the tank. For large size tanks that is 55 m diameter or above, the bridge sometimes extends to the full diameter driven at both ends and scrapers are attached to the bridge by vertical supports.

For square tanks, a fixed bridge up to the centre of the tank is provided. Raking arms extending full diameter have pivoted pentographaction extensions with corner blades attached to the outer ends.

*Liquid flow measurement in open channels using thin plate weirs.

Corrosion resistant wheels mounted on the extension arms ride against steel plates embedded in the side walls to guide corner scraper blades. The pivoted extension of arms kept in contact with the tank walls at all times by a spring.

5.3 Scraper Drive

5.3.1 *Centre Drive* — Centre drive mechanism shall consist of a drive unit with overload alarm, tipping device, structural steel scraper arms and bridge, handrail, walkway (up to the centre). It shall be arranged to provide the required speed. It shall consist of internal and external spur gear and pinion assembly driven by a motor through a series of reduction gear boxes which in turn will provide the required speed to the scraper arms. The chain drive may be incorporated, if necessary. The reduction gear shall preferably be oil-immersed type, and the motor shall conform to the requirements of IS : 325-1970* or IS : 996-1964† as applicable.

5.3.2 This drive is mounted on an end carriage on which the rotating bridge is also mounted. The drive consists of a motor and reduction gear box driving the traction wheel through a spur or bevel gear or chain drive. The tip speed for circular tanks shall be around 0·3 m/min or below.

5.4 Protective devices for motors to stop against overload shall be provided.

5.5 Bridge — If bridge is less than 90 cm high, hand railing shall be provided on top beam so as to make a total height of 1·0 m.

6. TESTING OF SCRAPPING MECHANISM

6.1 Bridge or centre drive shall be run in dry condition to check alignment of traction wheels, rails and mechanical fouling of scrapping arms and blades with floor or walls of the tank. Particular attention shall be given to the traction wheel so that it never slips on the rails. Dry running should be continued for at least 4 to 5 hours.

7. PAINTING

7.1 All fabricated surfaces to be painted shall be thoroughly dried and freed from rust and grease. All steel components shall be given coat of red oxide primer and three coats of finish paint [*see* IS : 1477 (Part I)-1971‡ and IS : 1477 (Part II)-1971§].

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*Specification for three-phase induction motors (*third revision*).

†Specification for single-phase small ac and universal electric motors (*revised*).

‡Code of practice for painting of ferrous metals in buildings : Part I Pretreatment (*first revision*).

§Code of practice for painting of ferrous metals in buildings : Part II Painting (*first revision*).

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